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(54) **WORKPIECE RECOVERY UNIT**

(56) **References Cited**

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U.S. PATENT DOCUMENTS

2004/0060402 A1 * 4/2004 Shimada et al. 82/124
2009/0151524 A1 * 6/2009 Hioki et al. 82/124
2009/0260492 A1 * 10/2009 Maehara et al. 82/152

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FOREIGN PATENT DOCUMENTS

CN 1880011 A 12/2006
CN 101528410 A 9/2009

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(Continued)

OTHER PUBLICATIONS

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B23Q 7/04 (2006.01)

B23Q 11/08 (2006.01)

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CPC **B23Q 7/00** (2013.01); **B23Q 7/008** (2013.01);

B23Q 7/04 (2013.01); **B23Q 11/08** (2013.01)

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CPC B23Q 7/008; B23Q 7/00; B23Q 7/048;

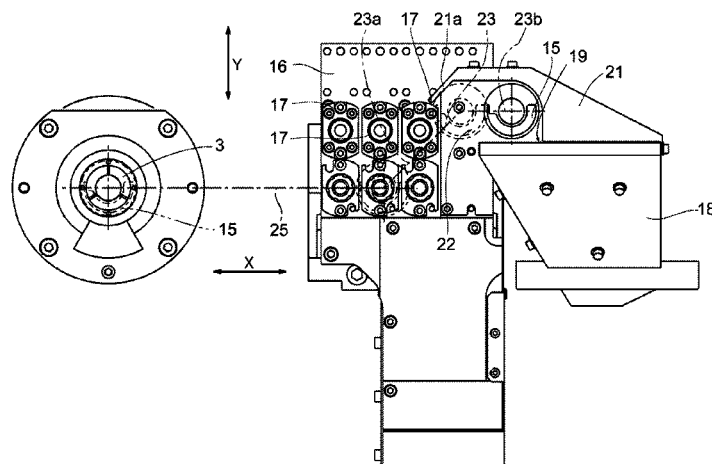
B23Q 11/08; B23Q 7/12

See application file for complete search history.

(57) **ABSTRACT**

To prevent entrance of swarf or cutting oil from a workpiece recovery opening, in a workpiece recovery unit, a cover **21** which covers an upper side and a lateral side of a workpiece recovery opening **19** opening in an upper side of a workpiece recovery section **18** disposed lateral to a holder **13** which holds a processed workpiece **1'**, a workpiece transport path **23** from an entrance **22** opening in a lower side provided in the cover **21** to the recovery opening **19** is formed in a step-like shape, the holder **13** is supported so as to be movable in an up-and-down direction and a right-and-left direction, the workpiece **1'** is moved along the transport path **23** by the holder **13**, and is transported to the upper side of the recovery opening **19** from the entrance **22** so as to be recovered in the recovery opening **19**.

5 Claims, 4 Drawing Sheets



(56)

References Cited

FOREIGN PATENT DOCUMENTS

EP	1402998 A2	3/2004
EP	1518639 A2	3/2005
JP	H05-041605 U	6/1993
JP	2000-126972 A	5/2000
JP	2002-178238 A	6/2002

JP	2004-114226 A	4/2004
JP	2009-142920 A	7/2009
WO	2008/054018 A1	5/2008

OTHER PUBLICATIONS

International Search Report; PCT/JP2012/054196; Apr. 17, 2012.

* cited by examiner

FIG. 1

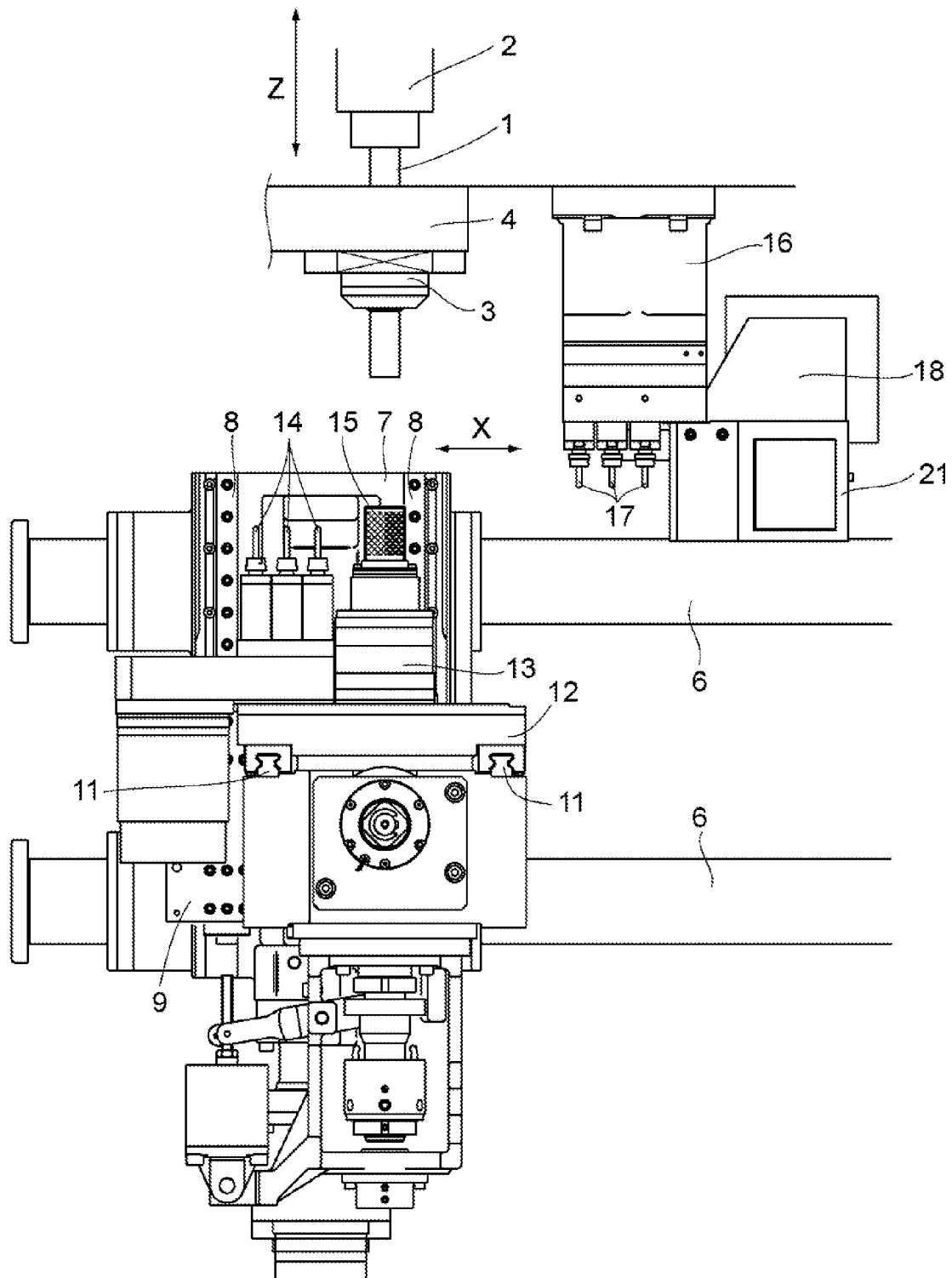


FIG.2

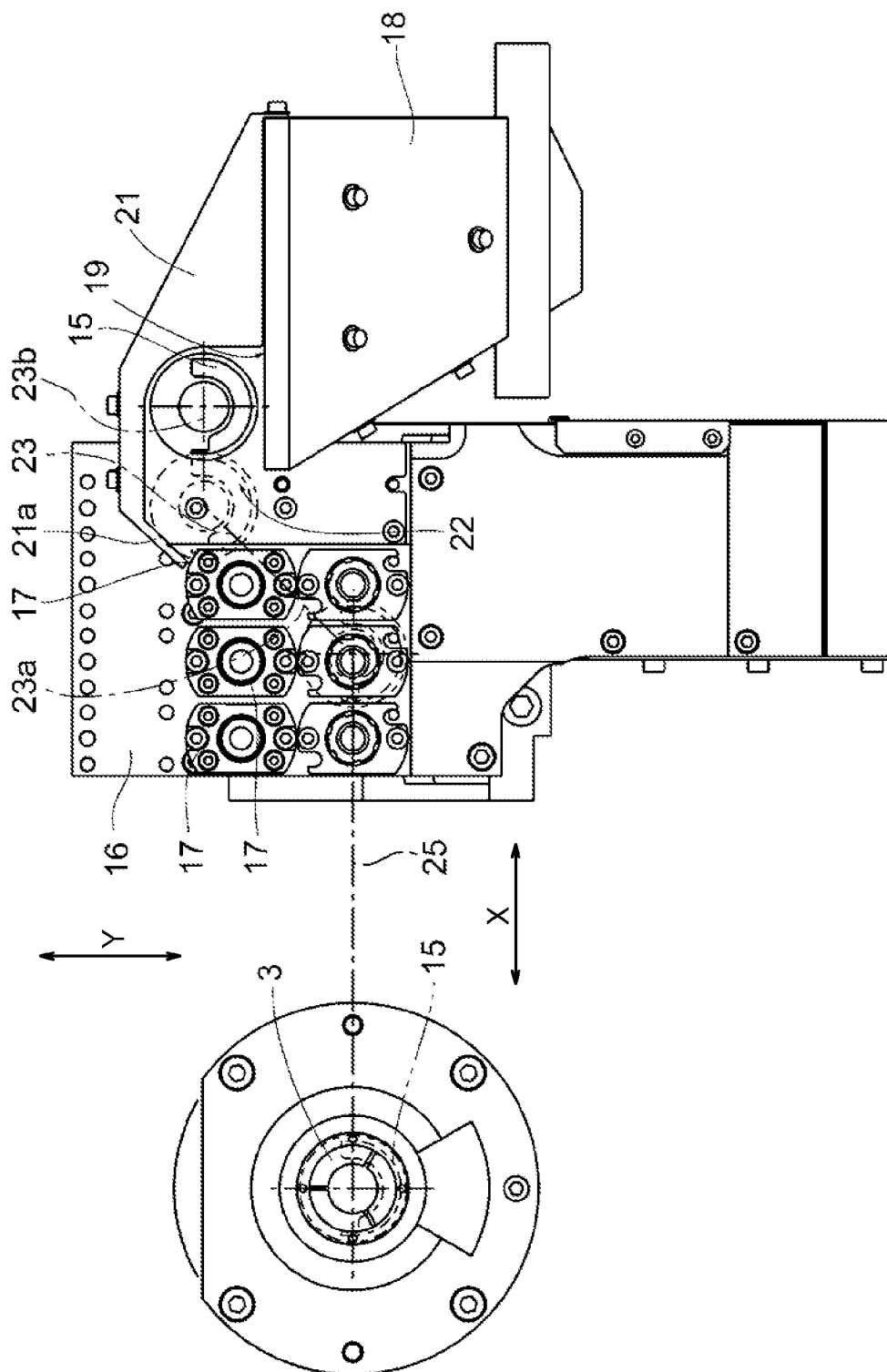


FIG.3

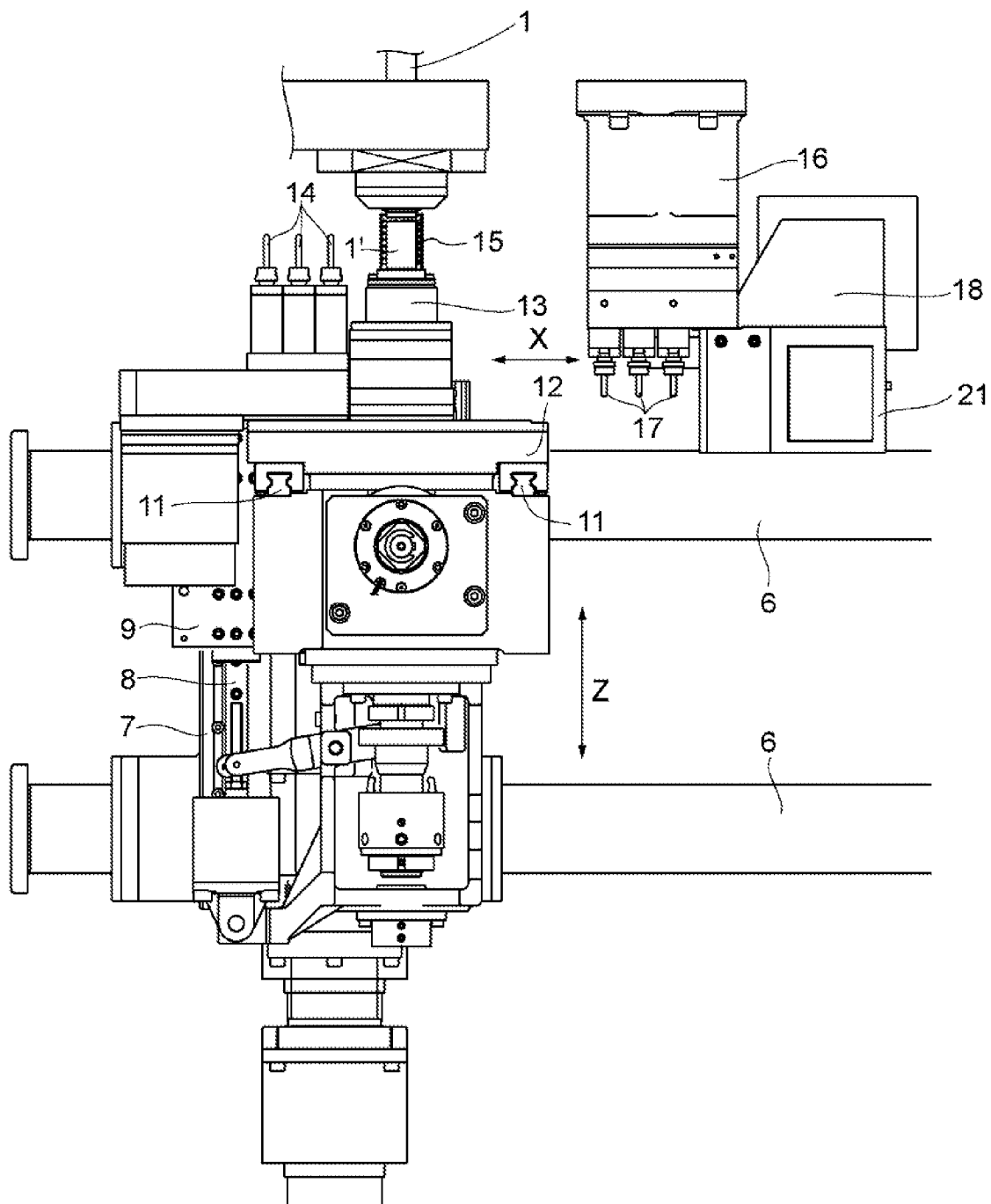
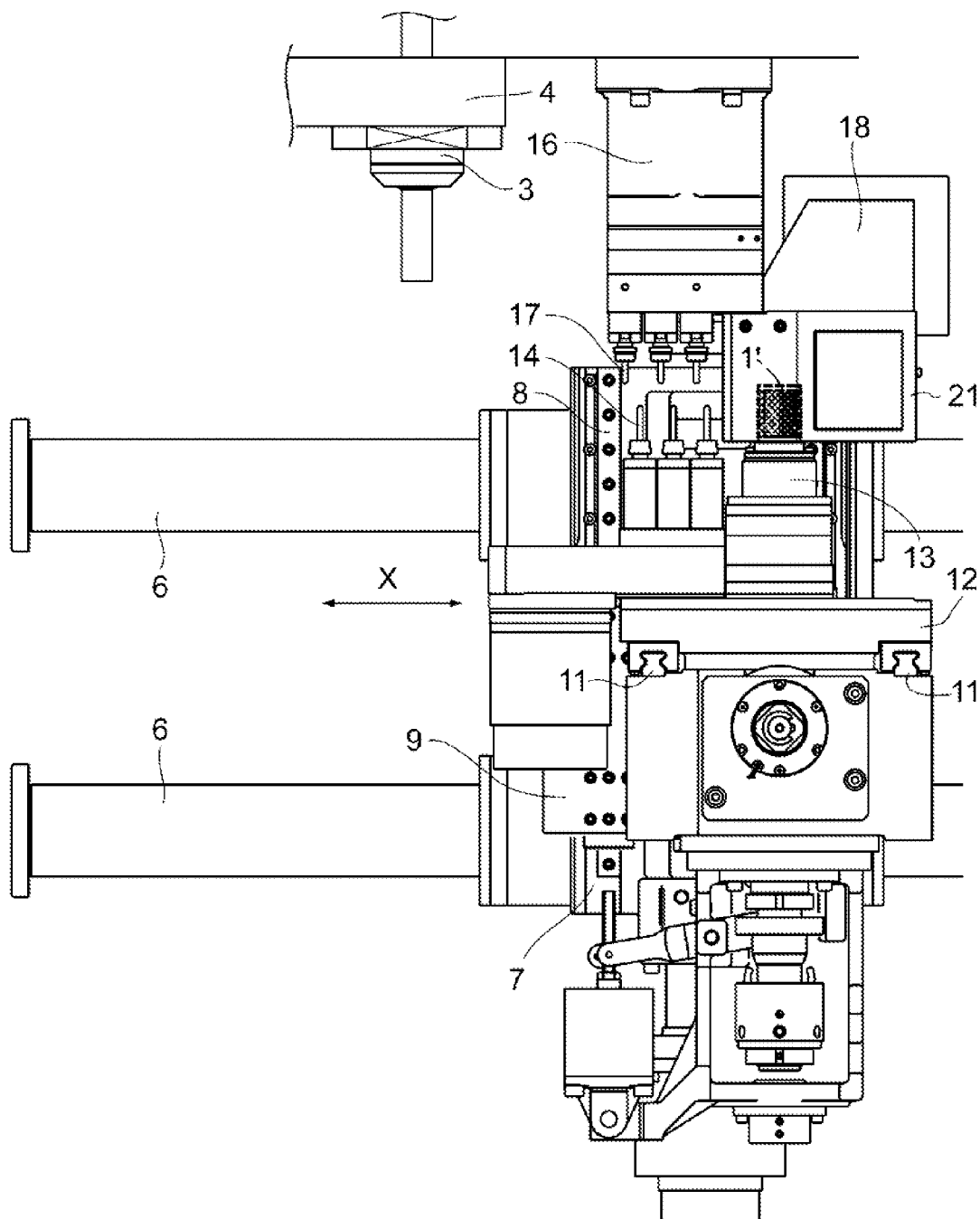


FIG.4



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WORKPIECE RECOVERY UNIT**TECHNICAL FIELD**

The present invention relates to a workpiece recovery unit. 5

BACKGROUND ART

A workpiece recovery unit including a holder, which holds a processed workpiece, and a recovery section for a material, which is disposed laterally to the holder, is conventionally known (refer to Patent Document 1, for example). In such a workpiece recovery unit, the holder is provided so as to be movable toward the recovery section, the workpiece is transported to the recovery section by the movement of the holder, and the processed workpiece is recovered in the recovery section. 10

RELATED ART DOCUMENT

Patent Document

Patent Document 1: JP 2000-126972A

SUMMARY OF INVENTION**Technical Problem**

However, such a workpiece recovery unit has a problem in that swarf or cutting oil while processing a workpiece easily enters the recovery section because the recovery section has an opening in the upper side thereof, and the workpiece is recovered in the recovery section through the opening. 15

Solution to Problem

To solve the above problem, first, a workpiece recovery unit of the present invention includes a holder which holds a processed workpiece, and a workpiece recovery section disposed lateral to the holder; wherein the recovery section includes a workpiece recovery opening which opens in an upper side thereof, the holder is provided so as to be movable toward the recovery section, the workpiece is transported to the recovery section to be recovered through the recovery opening, the recovery section is provided with a cover which covers the upper side and a lateral side of the recovery opening, the cover is provided with an entrance which opens downwardly, a workpiece transport path from the entrance to the recovery opening is formed in a step-like shape, the holder is supported so as to be movable in an up-and-down direction and a right-and-left direction to be moved along the transport path, and the workpiece is transported to the upper side of the recovery opening from the entrance by the holder to be recovered in the recovery opening. 20

Second, the holder comprises a spindle of a machine tool. 25
Third, the machine tool includes two spindles which are opposed to each other to transfer the workpiece, the holder comprises one of the spindles, and the recovery section is provided such that the recovery opening is disposed in a position higher than that of a shaft center of the two spindles when transferring the workpiece. 30

Effect of Invention

According to the workpiece recovery unit of the present invention as described above, the entrance of swarf, cutting oil or the like in the recovery opening from the upper side and 35

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the lateral side can be prevented by the cover. Thus, the processed workpiece can be stably transported by the holder, and can be recovered.

In addition, since the holder is made of the spindle of the machine tool, it becomes unnecessary to further provide another holder. Specifically, since the gripper is made of one of the two spindles which are opposed to each other to transfer the workpiece, and the recovery section is provided such that the recovery opening is disposed in a position higher than that of the shaft center of both spindles when transferring the workpiece, the entrance of swarf, cutting oil or the like while processing a workpiece can be effectively prevented. 40

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of a main part of an automatic lathe including a workpiece recovery unit of the present invention. 45

FIG. 2 is a front view of the substantial part of the automatic lathe including the workpiece recovery unit of the present invention. 50

FIG. 3 is a plan view of the substantial part of the automatic lathe in which a processed workpiece is received in a workpiece recovery basket from a front spindle.

FIG. 4 is a plan view illustrating the substantial part of the automatic lathe in which the processed workpiece is transported above a chute. 55

DESCRIPTION OF EMBODIMENT

One embodiment of a workpiece recovery unit of the present invention will be described with reference to an example of an automatic lathe, which is a machine tool including the workpiece recovery unit of the present invention. 60

As illustrated in FIG. 1, the automatic lathe includes a front spindle 2 which detachably grips a workpiece 1. The front spindle 2 is supported so as to be rotatable about a shaft center and slidable in the axis line direction (Z-axis direction). A guide bush 3 through which the workpiece 1 gripped by the front spindle 2 is inserted is disposed in front of the front spindle 2. 65

The guide bush 3 is mounted on a guide bush support base 4, and guides the workpiece 1 so as to be rotatable and slidable along the Z-axis direction. The guide bush support base 4 is fastened on a bed of the automatic lathe. An X slide rail 6 extending along the X-axis direction orthogonal to the Z-axis direction in the right-and-left direction is provided in front of the guide bush 3 on the bed. An X slide base 7 is mounted on the X slide rail 6 so as to be slidable along the X-axis direction. 70

A Z slide rail 8 extending along the Z-axis direction is provided in the X slide base 7 side. A Z slide base 9 is mounted on the Z slide rail 8 so as to be slidable along the Z-axis direction. 75

A Y slide rail 11 extending along the Y-axis direction (refer to FIG. 2) orthogonal to the X-axis direction and the Z-axis direction in the up-and-down direction is provided in the Z slide base 9 side. A support base 12 is mounted on the Y slide rail 11 so as to be slidable along the Y-axis direction. 80

A back spindle 13 is supported by the support base 12 so as to be rotatable about the shaft center, and opposed to the front spindle 2. The back spindle 13 is configured to grip the workpiece 1 in a detachable manner. 85

The support base 12 is provided with a front processing tool 14 which processes the workpiece 1 gripped by the front spindle 2. The support base 12 is located in the lateral position of the back spindle 13. In this embodiment, the front process- 90

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ing tool **14** is a tool line in which a plurality of tools are disposed along the X-axis direction, and a plurality of tool lines are arranged along the Y-axis direction.

Each of the front processing tools **14** and the back spindle **13** integrally slide along the X-axis direction, Z-axis direction and Y-axis direction with the above configuration.

A back tool post **16** is fastened on the bed side in the lateral position of the guide bush **3**. A back processing tool **17** which processes the workpiece **1** gripped by the back spindle **13** is attached to the back tool post **16**.

In this embodiment, the back tool post **16** is configured such that a plurality of back processing tools **17** is disposed along the X-axis direction as a tool line, and a plurality of tool lines is arranged along the Y-axis direction.

The automatic lathe is configured to select a predetermined front processing tool **14** by the movement of the support base **12** along the Y-axis direction and the movement of the X slide base **7** along the X-axis direction, and process a part of the workpiece **1** projected from the guide bush **3**, which is gripped by the front spindle **2**, by the selected front processing tool **14**. The workpiece **1** can be transferred between the front spindle **2** and the back spindle **13** by moving the support base **12** such that the front spindle **2** and the back spindle **13** are concentrically disposed.

By transferring the workpiece **1**, the processed workpiece **1** gripped by the front spindle **2** can be delivered to the back spindle **13**. A predetermined back processing tool **17** is selected by the movement of the support base **12** along the Y-axis direction and the movement of the X slide base **7** along the X-axis direction, and the workpiece **1** gripped by the back spindle **13** can be processed with the selected back processing tool **17** by the movement of the support base **12**. For example, the processed workpiece **1'** gripped by the front spindle **2** can be gripped by the back spindle **13** so as to be further processed.

However, in the present embodiment, a workpiece recovery basket **15** which receives the workpiece **1'** processed by the front spindle **2** is integrally fastened to the back spindle **13**, so that the workpiece **1'** is not processed by the back spindle **13**.

As illustrated in FIG. **3**, the back spindle **13** is brought close to the front spindle **2** so as to be concentric with the front spindle **2**, and the processed workpiece **1'** obtained by cutting the workpiece **1** is received in the workpiece recovery basket **15** so as to be held in the back spindle **13**.

A chute **18** which recovers the processed workpiece **1'** held in the back spindle **13** is provided lateral to the back processing tool **17**. The chute **18** is fastened to the back tool post **16**. The chute **18** can be easily mounted by removing a part of the back processing tool **17** from the back tool post **16**, and using the mounted portion of the back processing tool **17** of the back tool post **16**.

The chute **18** is formed in a box shape having in the upper side thereof an opening, and the opening constitutes a recovery opening **19**. By dropping the workpiece **1'** in the recovery opening **19**, the workpiece **1'** can be recovered in the chute **18**. The chute **18** is disposed such that the recovery opening **19** is located in a position higher than that of the shaft center when transferring the workpiece **1** between the back spindle **13** and the front spindle **2**.

A cover **21** which covers the upper side and the lateral side of the recovery opening **19** is fastened to the chute **18**. A part of the lateral side of the cover **21**, which is opposed to the back spindle **13**, opens to allow at least the passage of the workpiece recovery basket **15** as the after-described transport path **23**.

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A lateral portion **21a** of the cover **21** on the back spindle **13** side extends to the neighborhood of the back processing tool **17** toward the guide bush **3** through the area over the recovery opening **19**, and the leading end portion of the extended portion inclines oblique downward. An entrance **22**, which is divided by the leading end portion and the upper edge of the chute **18** and opens downward, is formed.

In the present embodiment, the entrance **22** is formed in the oblique downward direction. The transport path **23** for transporting the processed workpiece **1'** is formed from the entrance **22** to the upper side position of the recovery opening **19**.

In the present embodiment, the transport path **23** includes an oblique upward straight inclination path **23a** from the end of the entrance **22** to the lateral side of the recovery opening **19** and an approximate horizontal path **23b** from the end of the inclination path **23a** to the upper side of the recovery opening **19**. The transport path **23** is formed in a step-like path from the entrance **22** to the upper side position of the recovery opening **19** to have a space which allows at least the passage of the workpiece recovery basket **15**.

The height of the shaft center of the front spindle **2** is set so as to be substantially the same as that of the end of the inclination path **23a**. The back spindle **13** moves toward the end of the inclination path **23a** along the approximate horizontal path **25** upon the reception of the processed workpiece **1'** from the front spindle **2**.

As illustrated in FIGS. **2**, **4**, after the workpiece recovery basket **15** is moved toward the end of the inclination path **23a** along the path **25** by the movement of the support base **12**, the back spindle **13** is moved oblique upward along the inclination path **23a**.

The workpiece recovery basket **15** is introduced in the cover **21** through the entrance **22** in the middle of the inclination path **23a**, and is moved to the upper side of the recovery opening **19** along the horizontal path **23b**, so that the workpiece **1'** held in the back spindle **13** can be transported.

By rotating the back spindle **13** with the workpiece recovery basket **15** being located above the recovery opening **19**, the workpiece **1'** housed in the workpiece recovery basket **15** is dropped in the recovery opening **19** so as to be recovered in the chute **18**. In addition, since a part of the lateral side of the cover **21**, which is opposed to the back spindle **13**, opens, the movement of the back spindle **13** cannot be disturbed.

In the automatic lathe, the workpiece recovery unit includes the back spindle **13** as a holder which holds the processed workpiece **1'** and the chute **18** as a recovery section.

In the workpiece recovery unit, the entrance of swarf, cutting oil or the like in the recovery opening **19** from the upper side and the lateral side can be prevented by the cover **21**. Therefore, the processed workpiece **1'** can be stably transported and recovered by the back spindle **13**.

Since the transport path **23** is a combination of the straight paths, the cover **21** and the transport path **23** can be simplified, and the entrance of swarf or cutting oil in the recovery section **18** can be prevented with a simple configuration.

Moreover, the processed workpiece **1'** can be transported along the transport path **23** and the path **25**, so that the movement stroke along the Z-axis direction of the support base **12** can be controlled; thus, the automatic lathe can also be downsized. With the back processing tool **17** located below the entrance **22** being unmounted, the back spindle **13** can be quickly brought close to the back tool post **16**, and the workpiece **1'** can be transported in the chute **18**. The movement stroke of the support base **12** along the Z-axis direction can be therefore further reduced.

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In addition, without mounting the work recovery basket **15** in the back spindle **13**, the workpiece processed in the front spindle **2** can be gripped by the back spindle **13** so as to be transferred, and the processed workpiece **1'** can be transported to the upper side of the recovery opening **19** while gripping the processed workpiece **1'** by the back spindle **13** so as to be recovered in the chute **18**. In this case, the workpiece **1'** processed in the front spindle **2** is gripped by the back spindle **13** so as to be further processed, and the further processed workpiece **1'** gripped by the back spindle **13** can be recovered in the chute **18**.

The transport path **23** can be obtained by the combination of paths along a vertical line or a circular arc line according to a shape of the cover **21** or a shape of a structure around the cover **21** in addition to the combination of the straight inclination path **23a** and the approximate horizontal path **23b**.

The entrance **22** opens in the vertical downward direction. With this configuration, the transport path can be constituted by the combination of the horizontal path and the vertical line path. In this case, the lateral side of the recovery opening **19** can be almost completely covered by the cover **21**. As such, the entrance of scattering swarf, cutting oil or the like in the recovery opening **19** can be reduced.

CROSS REFERENCE TO RELATED APPLICATION

The present application is based on and claims priority from Japanese Patent Application No. 2011-069977, filed on Mar. 28, 2011, the disclosure of which is hereby incorporated by reference in its entirety.

DESCRIPTION OF REFERENCE NUMERALS

1' processed workpiece
13 back spindle (holder)
18 chute (recovery section)
19 recovery opening
21 cover
22 entrance
23 transport path

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The invention claimed is:

1. A workpiece recovery unit, comprising:
 a holder which holds a processed workpiece; and
 a workpiece recovery section disposed lateral to the holder;
 wherein

the recovery section includes a workpiece recovery opening, which opens in an upper side thereof,
 the holder is provided so as to be movable toward the recovery section,

the workpiece is transported to the recovery section so as to be recovered through the recovery opening,

the recovery section is provided with a cover which covers the upper side and a lateral side of the recovery opening,
 the cover is provided with an entrance which opens downwardly,

a workpiece transport path includes an inclination path extending through the entrance and a horizontal path extending from an end of the inclination path to an upper side position of the recovery opening,

the holder is supported so as to be movable in an up-and-down direction and a right-and-left direction so as to be moved along the transport path,

the workpiece is transported to the upper side of the recovery opening from the entrance by the holder so as to be recovered in the recovery opening, and

the cover has a lateral portion having a leading end portion that inclines oblique downward.

2. The workpiece recovery unit according to claim **1**, wherein the holder comprises a spindle of a machine tool.

3. The workpiece recovery unit according to claim **2**, wherein

the machine tool includes two spindles which are opposed to each other to transfer the workpiece,

the holder comprises one of the spindles, and

the recovery section is provided such that the recovery opening is disposed in a position higher than that of a shaft center of the two spindles when transferring the workpiece.

4. The workpiece recovery unit according to claim **1**, wherein the recovery section is formed in a box shape having the workpiece recovery opening in the upper side.

5. The workpiece recovery unit according to claim **1**, wherein the cover is fastened to the recovery section.

* * * * *